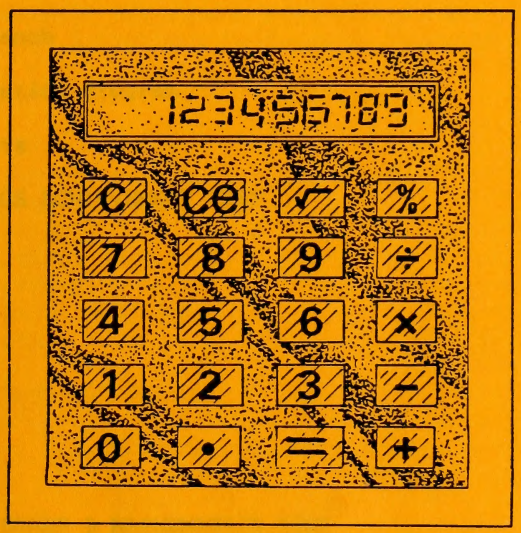
Student Achievement Testing Program Bulletin

Grade 9 Mathematics



1987-88 School Year

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INTRODUCTION

Purpose of the Bulletin

The Grade 9 Mathematics Achievement Test will be written on June 14, 1988. This bulletin provides general information about the achievement testing program, and a general description of the achievement test: an outline of the objectives to be tested, the test blueprint, and sample questions that demonstrate the nature and complexity of the test questions. Attached to the bulletin is the *Grade 9 Mathematics Curriculum Specifications* (revised May 1987) which is based on the *Program of Studies for Junior High Schools, 1978*. The curriculum specifications present the content and objectives from which the test questions are developed. Students should have access to the information in this bulletin, particularly to the sample questions.

A test that reflects the *Program of Studies for Junior High School*, 1987 has been developed. The description of such a test can be found in Appendix A.

Questions or comments regarding this bulletin should be addressed to:

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GENERAL INFORMATION

Purpose of the Achievement Testing Program

The Achievement Testing Program provides Alberta Education, school jurisdictions, and the public with information significant at the provincial and local levels about student knowledge, understanding, and skills in relation to program objectives. This program is not intended to provide information to be used for student placement or promotion.

The achievement tests are administered on a four-year cycle in four subject areas: language arts, social studies, mathematics, and science; and at three grade levels: 3, 6, and 9.

Nature of the Achievement Testing Program

The achievement tests are specific to the program of studies prescribed by the Minister of Education. Curriculum specifications for each subject area, prepared by the Curriculum Branch and the Language Services Branch of Alberta Education, identify the major content areas, the specific learning objectives within each content area, and the emphasis that each objective is to receive. The test questions reflect these curriculum specifications.

Classroom teachers from across the province are extensively involved in developing and field testing the questions. The student responses are analysed after field testing to determine each question's discriminating power and level of difficulty. Questions may undergo several revisions before they appear on the achievement test.

The final draft of each test is examined by the Achievement Test Review Committee that includes representatives of The Alberta Teachers' Association, the Conference of Alberta School Superintendents, Alberta's post-secondary institutions, and Alberta Education.

Exemptions from the Achievement Testing Program

The results of the Achievement Tests are significant at the school jurisdiction level. All students who have been taught the subject being tested are expected to participate in the Achievement Testing Program. Any exceptions should be identified by the principal and approved by the superintendent of schools.

The only students who may be excused from participating are those for whom the test is inappropriate. That is:

1. Students who are enrolled in an approved program that has been designed for special needs students.
2. Students who were taught the subject being tested in another semester or year.
3. Students who are enrolled in an English as a Second Language program.
4. Students who are being taught the specific subject being tested (mathematics, science, or social studies) in a language other than English.

Note: All Grade 6 students are expected to write the Grade 6 English Language Arts Achievement Test in 1988.

Exemptions for reasons other than those outlined must be approved by the Director of Student Evaluation and Records Branch.

Students Receiving Instruction in French

The French Language Arts Achievement Test and French translations of the mathematics, science, and social studies achievement tests are available for grades 6 and 9 according to the schedule on page 4. School jurisdictions that intend to have their students write achievement tests in French must notify Alberta Education prior to March 1, 1988.

Administration of the Achievement Testing Program

The Achievement Testing Program is administered in accordance with *Examination Regulation 531/82* pursuant to Section 11(1)(g) of the *School Act*. The achievement tests must be administered on the scheduled dates and may not be rescheduled.

The achievement tests should remain unopened until the time of administration. Duplication of any test materials, including the test booklets and answer sheets, is expressly forbidden.

Immediately following the administration of the scheduled achievement tests, the principal must ensure that test booklets and answer sheets are forwarded to school board offices. The school board is responsible for collecting and forwarding all test materials containing students responses to the Student Evaluation and Records Branch. Further details regarding procedures for returning these materials to the Branch will be issued when the achievement tests are delivered. For private schools, the Regional Offices of Alberta Education assume the responsibility for collecting and forwarding test materials to the Student Evaluation and Records Branch. All unused testing materials may be retained by the school jurisdiction.

Alberta Education will supervise the scoring of all achievement tests. The scoring of achievement tests by school personnel prior to returning test materials to the Student Evaluation and Records Branch is a violation of the Examination Regulations and contrary to the intent of the Achievement Testing Program.

During 1988, the achievement tests will be administered according to the following schedule:

Tuesday, June 14, 1988 (Morning)

Grade 3 Social Studies

Grade 6 English Language Arts

Grade 9 Mathematics*

Thursday, June 16, 1988 (Morning)

Grade 6 French Language Arts

In 1989, the achievement tests will be administered according to the following schedule:

Tuesday, June 13, 1989 (Morning)

Grade 3 English Language Arts

Grade 6 Social Studies*

Grade 9 Science*

*A French translation of this test is available. The French translation must be administered at the same time as the English version.

Reporting the Achievement Test Results

The provincial report presents the overall results for the province on major curriculum dimensions. Each jurisdiction wil receive a district profile of student achievement to parallel the provincial report, as well as guidelines for interpreting the jurisdictional results in relation to provincial norms. Alberta Education will not issue individual statements of results to students; individual student profiles will be returned to superintendents. The results of the 1988 Achievement Testing Program will be available in October 1988.

Consistent with our current interim French Student Evaluation Policy, provincial reports will not be prepared for the French translations of the achievement tests or for the Grade 6 French Language Arts Achievement Test in 1988. Part A: Composition of the Grade 6 French Language Arts Achievement Test will be scored centrally according to the same procedures used to score Part A: Composition of the Grade 6 English Language Arts Achievement Test.

Jurisdictions that choose to have their Francophone and/or French Immersion students write the Grade 6 French Language Arts Achievement Test and/or a French translation of the Mathematics 9 Achievement Test, will receive reports of jurisdiction and school results. Until the amount of time devoted to instruction in French is relatively uniform across the province, permitting valid and reliable interpretation of provincial data, provincial reports of achievement tests in French language programs will not be prepared.

DESCRIPTION OF THE GRADE 9 MATHEMATICS ACHIEVEMENT TEST

General Description

The Grade 9 Mathematics Achievement Test is designed to reflect the *Grade 9 Mathematics Curriculum Specifications* (revised May 1987). These specifications reflect the content objectives in the *Program of Studies for Junior High Mathematics, 1978*.

The time allotted for writing the Grade 9 Mathematics Achievement Test is 90 minutes.

The test consists of 75 multiple-choice questions with four alternatives. Students will record answers to questions on machine-scorable answer sheets.

Students will require HB pencils and erasers. They will also need scrap paper.

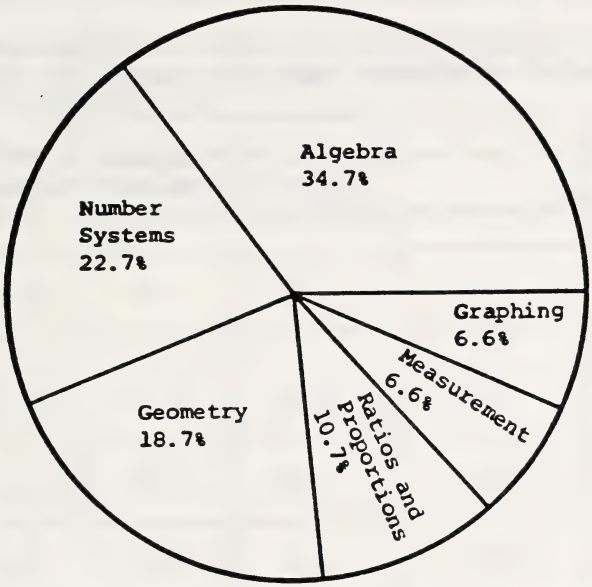
Students may use calculators while writing this test.

Content of the Test

The six strands in the core program of the Grade 9 Mathematics curriculum and the emphasis that each strand is to receive according to the *Grade 9 Mathematics Curriculum Specifications* (revised May 1987) form the basis for the achievement test. The six strands and the number of questions for each strand are as follows:

Strands	Number of Questions
Number Systems	17
Ratios and Proportions	8
Measurement	5
Geometry	14
Graphing	5
Algebra	26
Total	75

The relative emphasis given to each strand is shown in the circle graph below.



The scope of the Grade 9 Mathematics Achievement Test is limited to curriculum objectives that may be efficiently measured with paper and pencil. Test questions are limited to a multiple-choice format.

Questions on the test measure student achievement at four cognitive levels: knowledge, comprehension, application, and higher mental activities. An explanation of these cognitive levels is given in Appendix B.

Blueprint for the Achievement Test

The per cent emphasis for each strand and for each cognitive level are presented in the table below.

Strand	PER CENT EMPHASIS BY COGNITIVE LEVEL				Emphasis in %
	Knowledge	Comprehension	Application	Higher Mental Activities	
Number Systems	6.67	9.33	5.33	1.33	22.67
Ratios and Proportions	2.67	1.33	5.33	1.33	10.67
Measurement	1.33	1.33	2.67	1.33	6.67
Geometry	4.00	5.33	8.00	1.33	18.67
Graphing	-	1.33	5.33	-	6.67
Algebra	5.33	18.67	8.00	2.67	34.67
Emphasis in %	20.00	37.33	34.67	8.00	100.00

Sample Questions

Sample questions that reflect the nature and complexity of the questions that will appear on the achievement test are presented on the following pages.

Teachers are encouraged to familiarize their students with the type of questions that will appear on the achievement test by having the students work through the sample questions.

Please note that this collection of questions does not represent the test emphasis as presented in the blueprint.

1. The value of 6^3 is

   A. 18
   B. 54
   C. 216
   D. 729

2. $\frac{4}{5} \times \left(-3\frac{1}{8}\right) \times 2$ equals

   A. $-7\frac{13}{16}$

   B. -5

   C. $-\frac{3}{5}$

   D. 5

3. Pine nuts sell for \$18/kg and pecan nuts sell for \$12/kg. If Mrs. Jones bought 3 kg of pecan nuts and 2 kg of pine nuts, how much change would she receive from a \$100 bill?

   A. \$22
   B. \$28
   C. \$72
   D. \$78

4. The product of two whole numbers is 96. The sum of these numbers is less than 25. How many pairs of numbers satisfy these rules?

   A. 2
   B. 3
   C. 4
   D. 6

5. $\frac{5}{8}$ expressed as a per cent is

A. 160%
B. 62.5%
C. 1.6%
D. 0.625%

6. Tim is standing beside a spruce tree. He casts a shadow of 2.4 m and at the same time the tree casts a shadow of 26.0 m. If Tim is 1.8 m tall, the height of the tree is

A. 10.8 m
B. 14.4 m
C. 19.5 m
D. 34.7 m

7. The wholesale price of a dress was $60.00. The store owner increased the price by 30%. When the dress did not sell she reduced the increased price by 10% and the dress was sold. How much profit did she make from selling that dress?

A. $18.00
B. $12.00
C. $10.20
D. $6.00

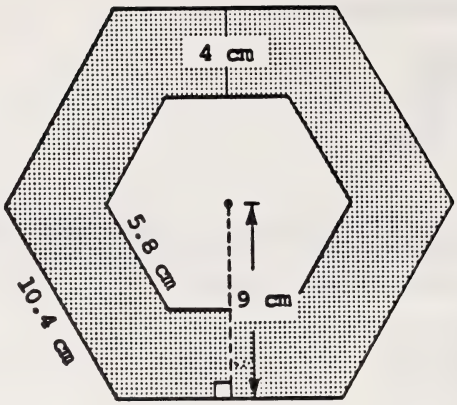
8. How do you change grams to kilograms?

A. Multiply by 100
B. Multiply by 1000
C. Divide by 100
D. Divide by 1000

9. The sum of 35 mm, 5 cm, and 0.26 dm is

A. 66 cm
B. 40.26 cm
C. 11.1 cm
D. 6.6 cm

10. The area of the shaded region in the diagram at the right is approximately



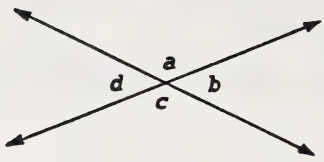
A. 422.2 cm²

B. 387.6 cm²

C. 211.2 cm²

D. 193.8 cm²

11. $\angle a$ and $\angle b$ are examples of

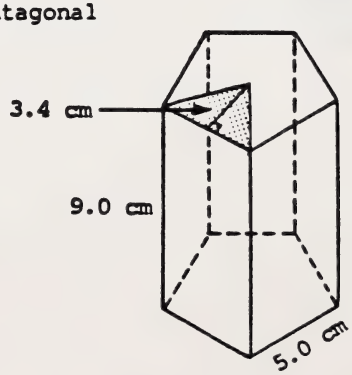


A. adjacent angles
B. alternate angles
C. corresponding angles
D. opposite angles

12. A 5 m ladder is leaning against a 4 m wall. If the top of the ladder reaches the top of the wall, how far is the foot of the ladder from the foot of the wall?

A. 3 m
B. 4 m
C. 5 m
D. 9 m

13. The total surface area of the regular pentagonal prism at the right is



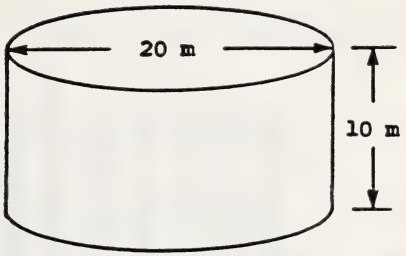
A. 85 cm²

B. 225 cm²

C. 310 cm²

D. 383 cm²

14. The volume of the cylindrical oil storage tank at the right is ($\pi = 3.14$)



A. 1000 m^3

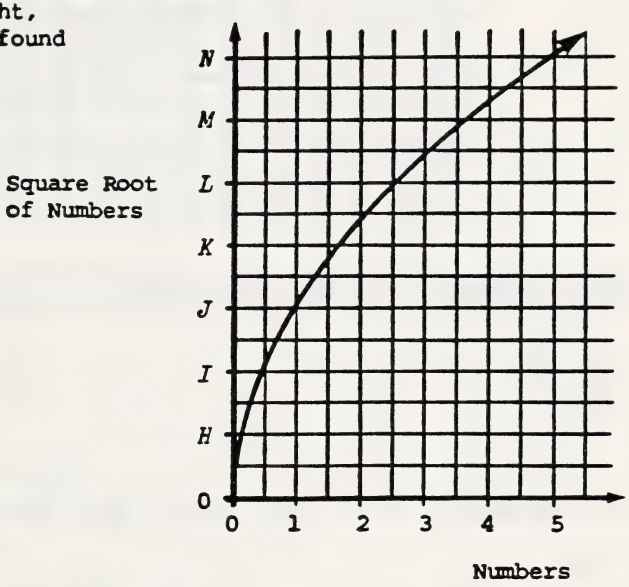
B. 1256 m^3

C. 3140 m^3

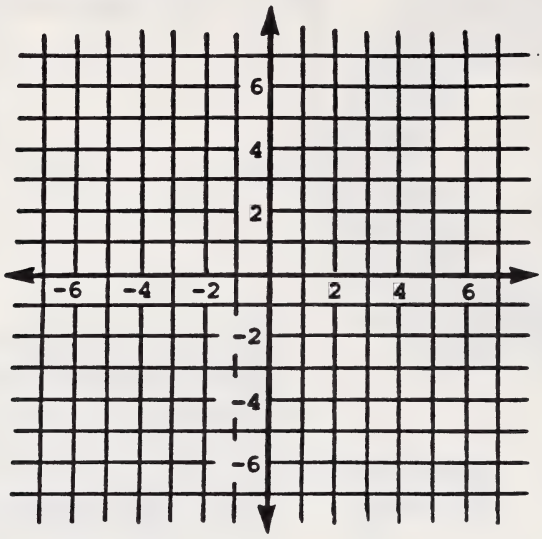
D. 6280 m^3

15. From the graph at the right, the value of $\sqrt{2.8}$ can be found between

A. *J* and *K*
B. *K* and *L*
C. *L* and *M*
D. *M* and *N*



16. Graph the relations $y = 4x$ and $y = -2x + 6$ on the grid below.



At what co-ordinates do they intersect?

A. (4, 1)
B. (1, 4)
C. (0, 6)
D. (0, 0)

17. In the expression $2a^2b + 4ab - 3ab^2 - 2ab$, the sum of the LIKE terms is

A. $2ab$

B. $6ab$

C. $-ab^2$

D. $-a^2b$

18. One factor of $x^2 + 20x + 96$ is

A. $(x + 24)$
B. $(x + 16)$
C. $(x + 8)$
D. $(x + 4)$

19. A square has each side greater than 1 cm. Two opposite sides of this square are each increased by 1 cm, while the other sides are each decreased by 1 cm. The area of the new figure as compared to the original square is

A. unchanged

B. increased by 1 cm^2

C. increased by 4 cm^2

D. decreased by 1 cm^2

20. John had a sum of money invested at 6%. Sally had $200 less than John, invested at 9%. They each earned the same interest. How much money did John have invested?

A. $120
B. $400
C. $600
D. $800

Key and Question Information

Item	Key	Cognitive Level	Curriculum Objective
1	C	Knowledge	Number Systems - writes the value for power (whole number exponent)
2	B	Comprehension	Number Systems - multiplies positive and negative rational numbers
3	B	Application	Number Systems - maintains previously developed skills in problem solving
4	A	Higher Mental Activities	Number Systems - maintains previously developed skills in problem solving (uses manipulatives, guesses, and checks)
5	B	Knowledge	Ratios and Proportions - converts a fraction to a per cent
6	C	Comprehension	Ratios and Proportions - uses ratios to solve problem involving distance and height
7	C	Higher Mental Activities	Ratios and Proportions - uses ratios and proportions to solve problem involving discount
8	D	Knowledge	Measurement - maintains previously developed skills (converts grams to kilograms)
9	C	Comprehension	Measurement - maintains previously developed skills (adds the different units of measure)
10	D	Higher Mental Activities	Measurement - calculates the area of a regular polygon
11	A	Knowledge	Geometry - maintains previously developed skills (knows definitions of angles)
12	A	Comprehension	Geometry - applies the Theorem of Pythagoras in solving problem

Key and Question Information

Item	Key	Cognitive Level	Curriculum Objective
13	C	Application	Geometry - finds the total surface area of a regular pentagonal prism
14	C	Application	Geometry - finds the volume of a cylinder
15	C	Comprehension	Graphing - reads approximate square root of the non-perfect square from the graph
16	B	Application	Graphing - makes graphs from the given relations and identifies the intersecting point of these graphs
17	A	Knowledge	Algebra - identifies and combines like terms
18	C	Comprehension	Algebra - identifies a factor of a trinomial
19	D	Application	Algebra - predicts the effect of altering specific elements of a formula
20	C	Higher Mental Activities	Algebra - solves the problem by writing an equation in one variable and solving same

APPENDIX A: DESCRIPTION OF THE NEW GRADE 9 MATHEMATICS TEST

General Description

The new Grade 9 Mathematics Test is designed to reflect the *Grade 9 Mathematics Curriculum Specifications** (March, 1987). These specifications reflect the content objectives in the *Program of Studies for Junior High Mathematics, 1987.*

The time allotted for writing the new Grade 9 Mathematics Test is 90 minutes.

The test consists of 75 multiple-choice questions with four alternatives in each. Students will record answers to questions on machine-scorable answer sheets.

Students will require HB pencils and erasers. They will also need scrap paper.

The use of calculators for writing this test is highly recommended.

Content of the Test

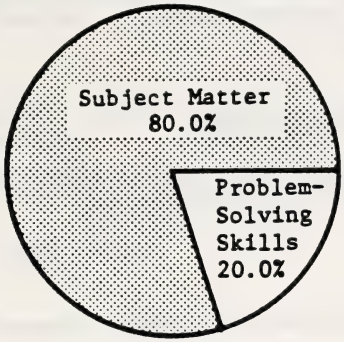
The two major components of the new Grade 9 Mathematics curriculum and the emphasis that each is to receive according to the *Grade 9 Mathematics Curriculum Specifications (March, 1987)* form the basis for the test. These two components are:

Component	Emphasis (%)
Subject Matter	80
Problem-Solving Skills	20

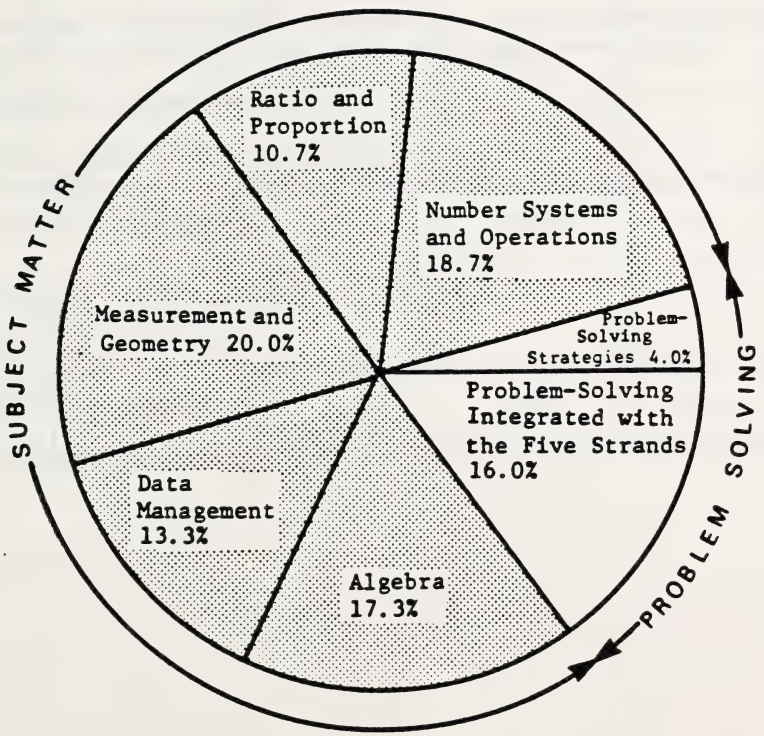
The scope of the new Grade 9 Mathematics Achievement Test is limited to curriculum objectives that may be effectively measured with paper and pencil tests. Test questions are limited to a multiple-choice format.

*The *new Grade 9 Mathematics Curriculum Specifications* will be available from Curriculum Branch in the fall of 1987.

The emphasis given to the subject matter and problem-solving skills components is shown in the circle graph below.



The subject-matter component covers five strands: number systems and operations, ratio and proportion, measurement and geometry, data management, and algebra. The problem-solving skills component is divided into two parts: problem-solving integrated with subject matter, and problem-solving strategies. The emphasis given to each subject-matter strand and to each part of the problem-solving skills component is shown in the circle graph below.



Questions on subject matter measure student achievement at three cognitive levels: knowledge, comprehension, and application. An explanation of these cognitive levels is given in Appendix B.

Blueprint for the new Grade 9 Mathematics Test

The per cent emphasis of questions that test subject matter and problem-solving skills is presented in the table below.

Content	Subject Matter by Cognitive Levels			Total Subject Matter	Problem Solving	Total Test
	Knowledge	Comprehension	Application			
Number Systems and Operations	6.67	10.67	1.33	18.67	2.67	21.33
Ratio and Proportion	2.67	2.67	5.33	10.67	5.33	16.00
Measurement and Geometry	4.00	9.33	6.67	20.00	4.00	24.00
Data Management	4.00	4.00	5.33	13.33	2.67	16.00
Algebra	1.33	14.67	1.33	17.33	1.33	18.67
Problem-Solving Strategies	-	-	-	-	4.00	4.00
TOTAL	18.67	41.33	20.00	80.00	20.00	100

APPENDIX B: EXPLANATION OF COGNITIVE LEVELS

Knowledge

- Pure recall or the ability to repeat material in the exact form in which it was presented
- Memorize facts, definitions, rules, procedures, and theories
- Perform routine computations

Comprehension

- Perform algorithms
- Demonstrate understanding of principles and concepts
- Interpret, translate

Application

- Solve typical problems
- Deal with activities that are routine in the sense that items similar to (but not identical to) these would have been studied
- Normally requires two steps:

  1. formulate the problem symbolically
  2. manipulate the symbolic representation according to some previously learned algorithms

Higher Mental Activities (Analysis, Synthesis)

- Solve novel problems
- Prove new results
- Generate new algorithms